

REMARKS

Claim 7 has been canceled, and Claims 1, 8, 11, 15, 17, 20, 21 and 23 have been amended. Claims 1-6, 8-21 and 23 are present in the application. In view of the foregoing amendments, and the remarks that follow, Applicants respectfully request reconsideration. The following remarks address the comments offered by the Examiner in the "Response to Arguments" section of the Office Action.

Claim Objections

The Office Action objected to dependent Claims 21 and 23, indicating that "a second wafer" should be changed to "the second wafer" at two locations in Claim 21, and that "a first wafer" should be changed to "the first wafer" at two locations in Claim 23. The foregoing amendments implement these changes.

Independent Claim 1 - Sakaguchi and Henley

Independent Claim 1 stands rejected under 35 USC §103 as obvious in view of a proposed combination of teachings from Sakaguchi U.S. Patent No. 6,221,738 and Henley U.S. Patent No. 6,013,563. This ground of rejection is respectfully traversed. In this regard, the PTO recognizes in MPEP §2142 that:

The examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. If the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness.

Applicants respectfully submit that Sakaguchi and Henley fail to establish a *prima facie* case of obviousness under §103 with respect to Claim 1, for mutually exclusive reasons that are discussed below.

THE REJECTION FAILS TO COMPLY WITH PTO REQUIREMENTS

The limitations of independent Claim 1 include a recitation of:

providing a first wafer with a surface comprising of a first semiconductor layer of a first natural lattice constant, wherein said first semiconductor layer is an alloy semiconductor layer comprising silicon and germanium, with a Ge mole fraction between about 5 to 80%;

forming a second semiconductor layer with a second natural lattice constant on the first semiconductor layer, said first and second natural lattice constants being different so as to introduce a strain gradient at the interface of said second semiconductor layer and said first semiconductor layer; . . . and

performing a water jet cleaving procedure at said strain gradient so that said second semiconductor layer is separated from said first semiconductor layer and said first wafer due to cleaving facilitated by said strain gradient.

The present Office Action relies on (1) an embodiment shown in Figures 4A-4D of Sakaguchi, and (2) a different embodiment discussed in "Example 6" of Sakaguchi. As to the embodiment of Figures 4A-4D, Applicants have previously pointed out that cleaving is caused by the porosity of the layer 103, without regard to whether layers 102 and 103 have lattice constants that are the

same or are different. More specifically, Sakaguchi specifically states in lines 15-18 of column 9 that:

... the separation layer can be formed without the use of heteroepitaxy [different lattice constants]. As an example, a porous material is used.

In other words, Sakaguchi expressly emphasizes that, in his invention, separation is effected through use of "a porous material", and "without the use of heteroepitaxy [different lattice constants]". Although Sakaguchi thus expressly teaches that his invention achieves cleaving through porosity, and not through different lattice constants, the Examiner insists that Sakaguchi does teach cleaving due to differing lattice constants. In particular, the Examiner points to Example 6 of Sakaguchi, and insists that:

... "example 6" of Sakaguchi clearly teaches the cleaving occurring due to a difference in lattice constants between a first layer 103 made of Ge and a second layer 102 made of Si.

However, the Examiner treats Figures 4A-4D and Example 6 as if they are the same embodiment. But in reality they are two separate and distinct embodiments, and they are combined improperly in the Office Action. More specifically, MPEP §706.02(j) explains that, in order to establish a prima facie case of obviousness under 35 U.S.C. §103, an examiner must satisfy four minimum requirements. In particular, MPEP §706.02(j) specifies that:

35 U.S.C. 103 authorizes a rejection where, to meet the claim, it is necessary to modify a single reference or to combine it with one or

more other references. After indicating that the rejection is under 35 U.S.C. 103, the examiner should set forth in the Office action:

(A) the relevant teachings of the prior art relied upon, preferably with reference to the relevant column or page number(s) and line number(s) where appropriate,

(B) the difference or differences in the claim over the applied reference(s),

(C) the proposed modification of the applied reference(s) necessary to arrive at the claimed subject matter, and

(D) an explanation why one of ordinary skill in the art at the time the invention was made would have been motivated to make the proposed modification.

In the present situation, the Office Action is combining two different embodiments from Sakaguchi, but fails to satisfy three of these four minimum requirements, as follows.

First, the rejection satisfies requirement (A), because it identifies the portions of Sakaguchi that are being relied upon.

But the rejection fails to satisfy requirement (B). In particular, for a proper rejection, the Office Action would need to identify all of the differences between Applicants' Claim 1 and the embodiment in Figures 4A-4D of Sakaguchi, including the fact that cleaving occurs in Figures 4A-4D due to porosity. However, the Office Action fails to identify all differences in the explanation of the §103 rejection (in section 4 on pages 2-4, and section 7 on pages 6-7).

Further, the rejection fails to satisfy requirement (C), because the explanation of the rejection never identifies any proposed modification of the embodiment of Figures 4A-4d of Sakaguchi that would be needed in view of the embodiment of Example 6 in order to arrive at the subject matter of Claim 1.

Moreover, the rejection fails to satisfy requirement (D), because the explanation of the rejection never discusses why one of ordinary skill in the art would have been motivated to modify the embodiment shown in Figures 4A-4D of Sakaguchi in view of the embodiment discussed in Example 6 of Sakaguchi.

Applicants therefore respectfully submit that the §103 rejection is defective, because it satisfies only one of the PTO's four minimum requirements for a §103 rejection. Consequently, the Examiner has failed to establish a prima facie case of obviousness under §103. For this reason alone, it is respectfully submitted that the pending §103 rejection must be withdrawn, and notice to that effect is respectfully requested.

PTO CANNOT ESTABLISH OBVIOUSNESS WITH ART THAT TEACHES AWAY

In evaluating obviousness, it is not proper to selectively consider only part of a reference, while ignoring other parts that teach away from the invention. In this regard, the provisions of MPEP §2141.02 specify that:

A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. (Emphasis in original).

In the present situation, and as discussed above, the Office Action insists that, in view of the embodiment discussed in Example 6 of Sakaguchi, it would be obvious that the different embodiment shown in Figures 4A-4D could be modified so that cleaving occurs due to differing lattice constants. However, Sakaguchi actually teaches just the opposite. In particular, Sakaguchi actually teaches that a layer of a porous material is provided, and that a force is applied to the porous layer in order to effect a separation due to porosity. Sakaguchi emphasizes that this "porosity" approach is superior to an approach that uses differing lattice constants. For

example, Sakaguchi states at lines 55-61 of column 11 that use of a porous layer without differing lattice constants is better because it:

... allows the transfer of an Si layer of excellent crystallinity or a non-porous single-crystal compound semiconductor layer onto the insulating surface of an economically excellent substrate having a large area, while sufficiently suppressing cracks resulting from a difference in lattice constant or in thermal expansion coefficient, which is a problem encountered by conventional methods

Sakaguchi also emphasizes, in lines 15-18 of column 9, that

... the separation layer can be formed without the use of heteroepitaxy. As an example, a porous material is used.

Thus, and contrary to the assertions in the Office Action, Sakaguchi criticizes the idea of using differing lattice constants. Consequently, even assuming that the embodiment of Example 6 uses differing lattice constants for cleaving, Sakaguchi's criticism of that approach means it would not be obvious to import that approach into other embodiments of Sakaguchi, such as the embodiment disclosed in Figures 4A-4D. The §103 rejection also relies on the Henley patent, but does not assert that Henley has any relevant teachings in regard to lattice constants. (In fact, it does not appear that Henley even mentions "lattice constants"). Consequently, Sakaguchi teaches directly away from Applicants' invention, and Henley adds nothing at all on this particular point.

Since it is well recognized that teaching away from a claimed invention is a per se demonstration of lack of prima facie obviousness, it is respectfully submitted that Sakaguchi and Henley do not factually support a prima facie case of obviousness with respect to Claim 1.

Accordingly, for this independent reason alone, it is respectfully submitted that Claim 1 is not obvious under §103 in view of Sakaguchi and Henley.

THE SUBJECT MATTER OF CLAIM 1 IS DIFFERENT FROM SAKAGUCHI

Sakaguchi discusses Example 6 in columns 19-20. Sakaguchi explains (for example at lines 23-30 of column 20) that the difference in lattice constants introduces defects, causing the SiGe interface to become weaker and to facilitate cleavage. As known in the art, the lattice mismatch between Si and Ge is 4%, and this is significant. Since Sakaguchi teaches (lines 63-65 of column 19) that his Ge has a thickness of 0.02 μm , Applicants believe that the Ge layer in Sakaguchi's Example 6 has a lot of defects that facilitate cleavage.

In contrast, Applicants do not want defects and, unlike Example 6, do not depend on defects to achieve cleaving. In fact, to avoid defects, Applicants do not use pure Ge, but instead use an alloy having a Ge mole fraction of 5% to 80% (as discussed in the originally-filed specification, and as recited in originally-filed Claims 8 and 17). Applicants depend on the large strain gradient across an interface between two materials with different natural lattice constants in order to achieve cleaving, which is an approach different from either the embodiment shown in Figures 4A-4D of Sakaguchi, or the embodiment discussed in Example 6 of Sakaguchi. The §103 rejection also relies on the Henley patent, but does not assert that Henley has any relevant teachings in regard to lattice constants. (In fact, it does not appear that Henley even mentions "lattice constants"). Consequently, Henley adds nothing at all to Sakaguchi on this particular point.

As noted in the preceding paragraph, Claim 1 now recites use of an alloy having a Ge mole fraction of 5% to 80%. Similar language previously appeared in dependent Claims 8 and 17. In addressing Claims 8 and 17, the Office Action cited Sharma U.S. Patent No. 5,344,524, and asserted that it would be obvious to replace Sakaguchi's Ge layer with the SiGe layer taught in Sharma. However, Applicants respectfully disagree. As discussed above, the Office Action relies on cleaving as taught in Sakaguchi's Example 6, where Sakaguchi teaches that cleaving

occurs due to defects caused by adjacent Si and Ge layers. Replacing the Ge layer with a SiGe layer would tend to significantly reduce or even eliminate the presence of defects. Since Example 6 of Sakaguchi depends on the defects to achieve cleaving, it would not be obvious to modify Example 6 in a way that significantly reduces or eliminates the defects. (As discussed in MPEP §2143.01, "If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious"). Accordingly, even if Sharma is taken into account, the subject matter of Claim 1 would not be rendered obvious.

It is therefore respectfully submitted that Sakaguchi, Henley and/or Sharma do not factually support a *prima facie* case of obviousness with respect to Claim 1. Accordingly, for this independent reason alone, it is respectfully submitted that Claim 1 is not obvious under §103 in view of Sakaguchi, Henley and/or Sharma

In view of each of the various different reasons discussed above, it is respectfully submitted that Claim 1 is not rendered obvious under §103 by the art applied by the Examiner. Claim 1 is thus believed to be allowable, and notice to that effect is respectfully requested.

Independent Claims 11 and 20

The limitations of independent Claim 11 include a recitation of:

providing a first wafer with a surface comprising of a first semiconductor material of a first natural lattice constant, wherein said first semiconductor material is an alloy semiconductor layer that includes silicon and germanium, with a Ge mole fraction between about 5 to 80%;

forming a second semiconductor layer with a second natural lattice constant on the first semiconductor material so that said second semiconductor layer is strained, said first and second

natural lattice constants being different so that a large strain gradient is formed at the interface of said second semiconductor layer and said first semiconductor material; . . .

performing a compressed air or pressurized fluid cleaving procedure at said strain gradient so that said second semiconductor layer is separated from said first semiconductor material due to cleaving facilitated by said strain gradient, resulting in a fourth wafer comprised of said second semiconductor layer and said second wafer;

The limitations of independent Claim 20 include a recitation of:

providing a first wafer having a first semiconductor layer with a first natural lattice constant, said first semiconductor layer being an alloy semiconductor layer that includes silicon and germanium, with a Ge mole fraction between about 5 to 80%;

forming a second semiconductor layer with a second natural lattice constant on the first semiconductor layer, said first and second natural lattice constants being different so as to form an interface with a large strain gradient; . . .

directing a pressurized fluid jet at said strain gradient so that said second semiconductor layer is separated from said first semiconductor layer and said first wafer due to cleaving facilitated by said strain gradient.

Independent Claims 11 and 20 each stand rejected under 35 USC §103 as obvious in view of a proposed combination of teachings from Sharma and Henley. These grounds of

rejection are each respectfully traversed. The rationale provided in the Office Action for these rejections is the same rationale provided for the rejection of Claim 1. Therefore, for reasons similar to those discussed above in association with Claim 1, it is respectfully submitted that Claims 11 and 20 are not rendered obvious under §103 by Sharma and Henley (with or without Sharma). Claims 11 and 20 are thus believed to be allowable, and notice to that effect is respectfully requested.

Dependent Claims

Claims 2-6 and 8-10, Claims 12-19 and Claims 21 and 23 respectively depend from Claim 1, Claim 11 and Claim 20, and are also believed to be distinct from the art of record, for example for the same reasons discussed above with respect to Claims 1, 11 and 20.

Conclusion

Based on the foregoing, it is respectfully submitted that all of the pending claims are fully allowable, and favorable reconsideration of this application is therefore respectfully requested. If the Examiner believes that examination of the present application may be advanced in any way by a telephone conference, the Examiner is invited to telephone the undersigned attorney at 972-739-8647.

Respectfully submitted,



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